

Claims:

1. A system for reducing the amount of oxygen in an oxygen-containing gas within a closed environment, comprising:

3 a source of hydrogen gas;

4 a controllable means for mixing, in response to a  
5 control signal, a selected amount of said hydrogen gas with a  
6 portion of said oxygen-containing gas from said closed  
7 environment to form a first gas mixture that includes  
8 hydrogen and oxygen;

9 a catalyst coupled to said controllable means for  
10 receiving said first gas mixture, said catalyst causing a  
11 reaction between said hydrogen and at least a portion of said  
12 oxygen in said first gas mixture wherein a second gas mixture  
13 is formed and returned to said closed environment, said  
14 second gas mixture having a lower percentage of oxygen than  
15 said first gas mixture; and

16 at least one oxygen sensor positioned in said closed  
17 environment and coupled to said controllable means for  
18 generating said control signal when oxygen levels in said  
19 closed environment reach a threshold level.

1. A system as in claim 1 wherein said source contains said  
2 hydrogen gas in its pure form.

1       3. A system as in claim 1 wherein said source of said  
2       hydrogen gas comprises a metal hydride material.

1       4. A system as in claim 1 wherein a volume percentage of  
2       said hydrogen gas in said first gas mixture is less than  
3       approximately one percent.

1       5. A system as in claim 1 wherein said catalyst is a  
2       precious metal.

1       6. A system as in claim 5 wherein said precious metal is  
2       selected from the group consisting of palladium and platinum.

1       7. A system as in claim 1 wherein said reaction caused by  
2       said catalyst is defined by a reaction of one-half mole of  
3       said oxygen in said first gas mixture with one mole of said  
4       hydrogen in said first gas mixture to produce water vapor and  
5       heat.

1       8. A system for reducing the amount of oxygen in an oxygen-  
2       containing gas within a closed environment, comprising:  
3               a source of hydrogen gas under pressure;  
4               a controllable valve having an input and an output,  
5        said input coupled to said source, said controllable valve  
6        dispensing a variable amount of said hydrogen gas from said  
7        input to said output in accordance with a control signal;  
8               a chamber coupled to said output of said controllable  
9        valve for receiving therein said variable amount of said  
10      hydrogen gas so-dispensed;  
11               means coupled to said chamber for drawing a portion of  
12      said oxygen-containing gas from said closed environment into  
13      said chamber wherein said variable amount of said hydrogen  
14      gas and said portion of said oxygen-containing gas combine to  
15      form a first gas mixture that includes hydrogen and oxygen;  
16               a catalyst coupled to said chamber for receiving said  
17      first gas mixture, said catalyst causing a water vapor-  
18      producing reaction between said hydrogen and at least a  
19      portion of said oxygen in said first gas mixture wherein a  
20      second gas mixture is formed and returned to said closed  
21      environment, said second gas mixture having a lower  
22      percentage of oxygen than said first gas mixture; and  
23               at least one oxygen sensor positioned in said closed  
24      environment and coupled to said controllable valve for

25 generating said control signal when oxygen levels in said  
26 closed environment reach a threshold level.

1 9. A system as in claim 8 wherein a volume percentage of  
2 said hydrogen gas in said first gas mixture is less than  
3 approximately one percent.

1 10. A system as in claim 8 wherein said catalyst is a  
2 precious metal.

1 11. A system as in claim 10 wherein said precious metal is  
2 selected from the group consisting of palladium and platinum.

1 12. A system as in claim 8 wherein said source of said  
2 hydrogen gas under pressure is maintained outside of said  
3 closed environment.

1       13. A system as in claim 8 wherein said reaction caused by  
2       said catalyst is defined by a reaction of one-half mole of  
3       said oxygen in said first gas mixture with one mole of said  
4       hydrogen in said first gas mixture.

1 14. A system as in claim 8 further comprising a pressure  
2 sensor for measuring ambient pressure inside said closed  
3 environment, said pressure sensor coupled to said at least  
4 one oxygen sensor for adjusting said threshold level in  
5 accordance with said ambient pressure.

1       15. A method of reducing the amount of oxygen in an oxygen-  
2       containing gas within a closed environment, comprising the  
3       steps of:

4               monitoring oxygen levels in said closed environment;

5               generating a control signal when said oxygen levels  
6       reach a threshold level;

7               mixing, in response to a control signal, a selected  
8       amount of hydrogen gas with a portion of said oxygen-  
9       containing gas from said closed environment to form a first  
10      gas mixture that includes hydrogen and oxygen;

11       exposing said first gas mixture to a catalyst capable  
12      of causing a reaction between said hydrogen and at least a  
13      portion of said oxygen in said first gas mixture wherein a  
14      second gas mixture is formed, said second gas mixture having  
15      a lower percentage of oxygen than said first gas mixture; and

16       dispensing said second gas mixture into said closed  
17      environment.

1       16. A method according to claim 15 wherein said reaction  
2       produces water vapor.

1       17. A method according to claim 15 wherein a volume  
2       percentage of said hydrogen gas in said first gas mixture is  
3       less than approximately one percent.

1       18. A method according to claim 15 wherein said step of  
2       mixing comprises the steps of:

3               providing an open chamber in said closed environment;  
4       and

5               injecting said hydrogen gas into said open chamber  
6       under pressure to draw said oxygen-containing gas into said  
7       open chamber.

1       19. A method according to claim 15 further comprising the  
2       steps of:

3               measuring ambient pressure inside said closed  
4       environment; and

5               adjusting said threshold level in accordance with said  
6       ambient pressure.

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Abstract

The present invention reduces the amount of oxygen in an oxygen-containing gas within a closed environment. A selected amount of hydrogen gas is mixed with a portion of the oxygen-containing gas from the closed environment to form a first gas mixture. A catalyst exposed to the first gas mixture causes a reaction between the hydrogen and at least a portion of the oxygen therein. The resulting second gas mixture, which is returned to the closed environment, has a lower percentage of oxygen. At least one oxygen sensor is positioned in the closed environment to determine when oxygen levels in the closed environment reach a threshold level. The output signal from the sensor is used to control when and/or how much hydrogen is mixed in the first gas mixture.

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